

---

IN THE UNITED STATES PATENT AND  
TRADEMARK OFFICE

---

Application Number::

Filed::

Applicant::

Won Gu KANG

Title::

Vaporizer with Integral Diaphragm

Attorney Docket::

SB06-PCT-US1008

Assignee:

Sebine Technology, Inc.

Customer No.:

33549

---

**Clean Version of Substitute Specification**

## VAPORIZER WITH INTEGRAL DIAPHRAGM

### Background

5     0001   The present invention relates to a vaporizer with integral diaphragm, and more particularly, a vaporizer with integral diaphragm which produces a gas needed for a semiconductor device fabricating process from a liquid source.

10     0002   Generally, in a semiconductor device fabricating process, a desired semiconductor device is fabricated through repetition of a film growing process such as epitaxial process and deposition process, and a pattern etching process to a semiconductor wafer. Above all, a criterion for the film growing process can become more and more severe as the semiconductor device is to be denser and more integrated.

15     0003   For example, a very thin film such as an insulating film for a capacitor or gate is required. Further, an electrode film or a wiring layer is required to be thin. For example, a method for forming the wiring layer was proposed, in which a copper film or an aluminum film is grown by using CVD (Chemical Vapor Deposition) method. In this case, a gas is vaporized from a liquid source so as to grow a film and used in the film growing process.  
20     The liquid source is vaporized by a vaporizer to produce a gas for making a film. In a conventional film growing process, a flow rate of the liquid source is very low.

25     0004   Therefore, for processing a film with high accuracy, a liquid source supplied to a vaporizer should be effectively vaporized, and thus vaporized gas source is supplied to a downstream of a film growing apparatus.

0005   Hereafter, a conventional vaporizer will be described with reference to Fig. 1.

30     0006   As will be seen from Fig. 1, a vaporizer 200 comprises: a source suction passage 231 for receiving a liquid source from an outside; a vaporizing chamber 235 for vaporizing the received liquid source; a gas transporting passage 232 for receiving a transporting gas

supplied for transporting a vaporized liquid source; a discharging port 238 for discharging the vaporized liquid source and the transporting gas from the vaporizing chamber 235; a vaporizing part 230 having a heater 234 for heating the vaporizing chamber 235; an adjusting part 210, positioned on the top end of the vaporizing part 230, for adjusting the amount of flow of the liquid source incoming into the vaporizing part 230; and an actuator 250 for controlling the adjusting part 210.

0007 In such constructed vaporizer 200, as the body of the vaporizer is heated by the heater 234 at all times, and the portion to which the liquid source is supplied is also heated by the conducted heat, there can occur a problem that the source can be metamorphosed and, in an acute case, can be decomposed. Further, there can be one other problem that the transporting gas 232 from the gas transporting passage 232 is not heated enough and flowed into the vaporizing chamber 235 to make variation of pressure and can flow backward to the gas transporting passage 232. Furthermore, there can be another problem that the vaporizer 200 is not constructed to heat the vaporizing chamber 235 concentratively, and the liquid source can not be vaporized effectively.

### **Brief Summary of the Invention**

0008 Therefore, the present invention can be devised to overcome the above mentioned problems, and an object of the present invention can include a vaporizer with an integral diaphragm, having a simple passage for passing a liquid source, which can prevent a space for a transported liquid source being heated to prevent a deformation of the liquid source, which can make a transporting gas supplied through a gas transporting passage in a vaporizing part be heated enough, and which can prevent flowing backward of the transporting gas, or the transporting gas from flowing into the gas transporting passage.

### **Brief Description of the Drawings**

0009 The above objects, other features and advantages of the present invention will become more apparent by describing the preferred embodiment thereof with reference to the accompanying drawings, in which:

5 0010 Fig. 1 is a schematic diagram showing a vaporizer according to a prior art;

0011 Fig. 2 is a schematic diagram showing a vaporizer embodiment according to the present invention;

10 0012 Fig. 3 is a schematic diagram showing an exploded vaporizer embodiment according to the present invention; and

0013 Fig. 4 is a schematic diagram showing a vaporizer embodiment with a heater block on the lower end thereof according to an embodiment of the present invention.

15

### **Detailed Description of Preferred Embodiment**

0014 Brief description of reference number\*

	10. Liquid source supplying part	11, 231: Source intaking/intake passage
20	12: Intaking/Intake tube	12a: Fine hole
	13: Stopper	14: Adjusting pin
	15: Diaphragm	16: Recess
	17: O-ring	18: Cooling device
	30, 230: Vaporizing part	31: First heater
25	32: Second heater	33: Temperature sensor
	35, 235: Vaporizing chamber	36: Gap
	37, 232: Gas transporting/transport passage	38, 238: Discharging/discharge port
	50, 250: Actuator	57: Heater block
	100: Vaporizer integral with diaphragm	200: Vaporizer
30	210: Adjusting part	234: Heater

0015 Reference will now be made in detail to preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

0016 Fig. 2 is a schematic diagram showing a vaporizer according to the present invention,  
5 and Fig. 3 is a schematic diagram showing an exploded vaporizer according to the present invention.

0017 As shown in the figures, a vaporizer according to the present invention can include a vaporizing part 30 for vaporizing a liquid source; a liquid source supplying part 10 for  
10 receiving the liquid source from outside and selectively supplying the received liquid source to the vaporizing part 40 by controlling the flow of the liquid source; and an actuator 50 for controlling the liquid source supplying part 10.

0018 The liquid source supplying part 10 can include a source intaking or intake passage  
15 11 for receiving the liquid source from outside; an intaking or intake tube 12 communicated with the source intaking or intake passage 11 and having a fine hole 12a for supplying the intaked liquid source to a vaporizing chamber 35; a stopper surface 13 formed on a portion of the source intaking or intake passage 11 perhaps near the intaking or intake tube 12; an  
adjusting pin 14 which is operated by the actuator 50 to control supply of the liquid source by  
20 positioning, or contacting and detaching the pin to and from the stopper 13 repeatedly; a diaphragm 15 which is responsive to the adjusting pin 14 in order to impart elasticity to the adjusting pin 14 such that the adjusting pin 14 is operated with the actuator 50 to repeat up and down oscillation; a built-in cooling device 18 for making the liquid source hold a low  
temperature in the liquid source supplying part 10; perhaps a recess 16 which is formed on a  
25 side contacted with the vaporizing part 30 in order to decrease the heat transmitted from the vaporizing part and to shut the inside of the vaporizer 100 from the outside; and a seal or perhaps O-ring 17 set on a position corresponding to the recess 16.

0019 The lower surface of the diaphragm can be formed as a part of a supplying or supply  
30 line for the liquid source formed by the source intaking or intake passage 11. In one other embodiment, the lower surface of the diaphragm can be separated from the supplying or

supply line for the liquid source formed by the source intaking or intake passage 11 to operate independently.

0020 In one embodiment, one end of the adjusting pin 14 is shaped as a cone, and the stopper is formed to have a corresponding opposite shape.

5

0021 However, it is preferable that a tilt angle of the one end of the adjusting pin 14 is slightly smaller than that of the stopper 13 to control a flow of the liquid source fine.

0022 The diaphragm 15 can not only impart elasticity to the adjusting pin 14, but also can prevent the liquid source from being flowed backward in the liquid source supplying part 10. Therefore, a separate elastic means such as a spring and the space for receiving the elastic means are not needed in order to give the elasticity to the adjusting pin 14.

0023 At the same time, a built-in cooling device 18 in the embodiment, the cooling device 18 can be installed in the liquid source supplying part 10, but is not limited to this. The cooling device 18 can be rather installed outside of the liquid source supplying part 10.

0024 Further, the recess 16 formed on the liquid source supplying part 10 and the O-ring can be formed on the vaporizing part 30 as far as it is not deviated from the object of the present invention of having a thermal minimization element that a thermal contact area for the liquid source supplying part 10 and the vaporizing part 30 is low, and the inside is shut or sealed from the outside.

0025 As described above, the recess 16 is formed on one item selected from the liquid source supplying part 10 and the vaporizing part 30 in order to minimize the thermal contact area, and the O-ring 17 is inserted into the recess 16.

0026 The vaporizing part 30 can be comprised of: a vaporizing chamber 35 which has a space extended downwardly in order to vaporize the liquid source ejected from the fine hole 12a of the liquid source supplying part 30; a gas transporting or transport passage 37 for supplying the vaporizing chamber 35 with the transporting or transport gas which transports

the vaporized liquid in the vaporizing chamber 35; a discharging or discharge port 38 for discharging the transporting gas and the vaporized liquid source to the outside; a first heater 31 such as positioned at the place between the gas transporting or transport passage 37 and the discharging or discharge port 38, to heat the vaporizing part 30 so as to vaporize the liquid, and to heat the gas transporting or transport passage 37 and the discharging or discharge port 38 at the same time so that the liquid, vaporized and discharged with the transporting gas, can maintain a stable state; a second heater 33 which can protrude into the inside of the vaporizing chamber 35 in order to heat the vaporizing chamber 35 in a concentrative fashion; and a temperature sensor 33, perhaps integral with the first and the second heaters 31 and 32.

0027 Herein, the gas transporting or transport passage 37 may be configured or inclined to increase a thermal contact area so that the transported gas is heated enough by the vaporizing part 30. And, when the gas transporting or transport passage 37 is communicated with the vaporizing chamber 35, the intaking or intake tube 12 can be projected into the vaporizing chamber 35 formed on the top end of the liquid source supplying part 10 to make a gap 36 around the intaking tube 12 and, the gas transporting or transport passage 37 can be connected the gap 36. Therefore, the transporting or transport gas supplied from the gas transporting or transport passage 37 is heated enough in the gap 36 to maintain pressure higher than that of a vaporizing zone in the vaporizing chamber and to prevent the transporting or transport gas from being flow backward from the vaporizing chamber 35 when the transporting or transport gas is flowed into the vaporizing chamber 35. At the same time, the liquid source which is supplied to the vaporizing chamber 35 through the fine hole 12a of the intaking tube 12 is prevented from being flowed into the gas transporting passage 37.

0028 The actuator according to the present invention may be either a manual actuator or a Piezo actuator.

0029 The operation and principle for embodiments of the present invention will be described in detail below.

0030 Referring to Figs. 2 and 3, a liquid source is flowed in through the source intaking passage 11 from the outside, and transported to the stopper surface 13. The transported liquid source is controlled by the adjusting pin 14 which is selectively in contact with the stopper surface 13.

0031 The principle in which the adjusting pin 14 is controlled by the actuator 50 and controls the liquid source in the stopper 13 is as follows.

10 0032 When the actuator 50, either a manual actuator or a Piezo actuator, is operated, the adjusting pin 14 in the liquid source supplying part 10 is also operated.

0033 The adjusting pin 14 is moved down by a falling or downward force of a motional means 53, and is moved up by the dynamic or elastic stability of the diaphragm 15. In operation, the adjusting means repeats the moving-up and moving-down, and the moving-up and down is possible by means of elasticity of the diaphragm 15.

0034 That is, the diaphragm 15 is acted as an elasticity element or means for moving up and down the adjusting means 14 repetitively.

20

0035 In addition, the diaphragm 15 also acts to prevent the liquid source from flowing backward upstream of the diaphragm 15.

0036 As described above, the moving-up and -down of the adjusting pin 14 makes a gap between the adjusting pin 14 and the stopper surface 13 to pass the liquid source, thus acting as a valve through the moving-up and -down.

0037 Herein, methods for contacting the adjusting pin 14 to the stopper 13 and detaching the adjusting pin from the stopper are as follows.

30



0038 One is such that spacing between the adjusting pin 14 and the stopper 13 is held in normal state, and the adjusting pin 14 is moved down together with the actuator 50 to be in contact with the stopper and is moved up by the elasticity of the diaphragm 15 to be apart from the stopper 13 when the motional means 53 is moved up. The other is such that the  
5 adjusting pin 14 is in contact with the stopper 13 in normal state, and is moved up by the elasticity of the diaphragm 15 when the actuator 50 is moved up.

0039 Further, as the tilt angle of the adjusting pin 14 is formed smaller than that of the stopper surface 13 to have the adjusting pin and the stopper surface hold different angles, the  
10 supplying of the liquid source is entirely blocked when the adjusting pin 14 is moved down to be in contact with the stopper surface 13.

0040 And, the liquid source is cooled enough by the cooling device 18 to the chemical reaction and deformation caused by the heat transferred from the vaporizing part 30 when the  
15 liquid source is in the liquid source supplying part 10.

0041 Meanwhile, the liquid on the stopper 13 is moved to the fine hole 12a in the inside of the intake tube 12 protruding into the vaporizing chamber 35 through the controlling of the adjusting pin 14, and is injected in the vaporizing chamber through the fine hole 12a and is  
20 heated enough to be vaporized by the second heater 32 which is formed to protrude in the vaporizing chamber 35.

0042 At the same time, the transport gas for transporting the liquid source is flowed into the vaporizing chamber 35 by means of the gas transport passage 37. The transport gas  
25 passing through the gas transport passage 37 is heated enough by the first heater 31, as the gas transport passage 37 is formed to be inclined.

0043 And, the gas transport passage 37 is communicated with the gap 36 which is formed between the upper inner circumference of the vaporizing chamber 35 and the intake tube 12  
30 of the liquid source supplying part 10, and the transport gas from the gas transport passage 37

is heated enough in the gap 36 to flow to the vaporizing chamber 35, but not to flow backward.

0044 Through the above processes, the liquid source vaporized in the vaporizing chamber  
5 35 is discharged by the transport gas to the discharge port 38. At this time, the transport gas and the vaporized liquid source are continuously heated by the first heater 31 formed in the vaporizing part 30.

0045 Further, the first and the second heaters 31 and 32 may include a temperature sensor  
10 33 which senses a temperature for an area around the first and second heaters 31 and 32 in real time to increase response to a variation of temperature. Therefore, portions of the inside of the vaporizing chamber 30 can properly maintain a temperature.

0046 Fig. 4 is a schematic diagram showing a vaporizer with a heater block on the lower  
15 end thereof according to an embodiment of the present invention. In the figure, the first and the second heaters 31 and 32 are unified as one heat block 57, rather than separated, and installed in the lower end of the vaporizing part 30. The heater block 52 may have a shape such that a column rests on a flat base and protrudes in order for the second heater 32, projecting into the inside of the vaporizing chamber 35, to perform its role. Furthermore, a  
20 column can be added in order for the first heater 31 to perform its role.

0047 With the above description, according to the present invention, effects that deformation of a liquid source caused by heating of a vaporizing space are prevented as a liquid source supplying part for transporting the liquid; source and a vaporizing part having a  
25 vaporizing chamber heated by a heater are thermally separated from each other, the liquid source is prevented from flowing into a gas transport passage as a gap is provided to induce a pressure difference in the passage in which the liquid source is flowed, the liquid source flowed in the vaporizing chamber is rapidly vaporized as the liquid source is heated by a heater projecting into the center of the vaporizing chamber, and the transporting gas is  
30 prevented from flowing backward as the transporting gas in the gas transporting passage is heated enough.

0048 Further, there are effects that the structure of the present invention is simple as an adjusting pin and a diaphragm is formed as one body and the diaphragm is acted upon by an elasticity means, and a loss of liquid source is reduced in an inner space of a passage for the  
5 liquid source.

## Claims

What is claimed is:

5

1. Vaporizer for vaporizing a liquid source, the vaporizer comprising:  
a liquid source supplying part 10 for supplying a liquid source;  
a vaporizing part 30 for vaporizing the liquid source; and  
an O- ring 17 positioned on a place in which the liquid source supplying part and the  
10 vaporizing part 30 are in contact with each other so as to minimize a thermal contact area for  
the liquid source supplying part 10 and the vaporizing part 30.

15

2. Vaporizer for vaporizing a liquid source, the vaporizer comprising:  
a liquid source supplying part 10;  
a vaporizing part 30;  
a recess 16;  
a O- ring 17;  
said liquid source supplying part including a source intaking passage 11 for receiving  
a liquid source, an intaking tube 12 communicated with the source intaking passage 11 and  
20 having a fine hole 12a formed thereon, a stopper 13 formed on a place at which the source  
intaking passage 11 and the intaking tube 12 are joined together, an adjusting pin 14 for  
controlling supplying of the liquid source from the source intaking passage 11 to the intaking  
tube 12, and a diaphragm 15 integral with the adjusting pin 14;

25

said vaporizing part 30 including a first heater 31 attached to a body of the vaporizing  
part 30 to heat the vaporizing part, a vaporizing chamber 35 for vaporizing the liquid source,  
a gas transporting passage 37 for supplying a transporting gas, and a discharging port 38 for  
communicating with the vaporizing chamber 35 and for discharging the transporting gas and  
the vaporized liquid source to the outside of the vaporizing chamber 35, and

30

said recess 16 being formed on selected one of the liquid source supplying part 10  
and the vaporizing part 30 to minimize a thermal contact area therebetween, and coupled  
with the O-ring 17.

3. The vaporizer as claimed in claim 2, wherein the lower surface of the diaphragm 15 is formed as a part of a supplying line for the liquid source formed by the source intaking passage 11.

5

4. The vaporizer as claimed in claim 2, wherein the lower surface of the diaphragm 15 is separated from the supplying line for the liquid source formed by the source intaking passage 11.

10 5. The vaporizer as claimed in claim 2, further comprising an actuator 50 adjacent to the upper side of the adjusting pin 14, wherein the adjusting pin 14 is; operated by the actuator.

15 6. The vaporizer as claimed in claim 2, wherein the vaporizing part 30 further comprises a second heater 32, the second heater being formed to protrude! into the vaporizing chamber 35.

20 7. The vaporizer as claimed in claim 1, wherein one end of the adjusting pin 14 is inclined and the stopper 13 has an corresponding inclined part, and the inclined angle of the adjusting pin is smaller than that of the stopper.

25 8. The vaporizer as claimed in claim 2, wherein the gas transporting part 37 is communicated with the gap 36 formed between the upper inner circumference of the vaporizing chamber 35 and the intaking tube 12 of the liquid source supplying part 10.

9. The vaporizer as claimed in claim 6, wherein the first and the second heaters 31 and 32 include a temperature sensor 33 capable of sensing a temperature of the region in real time between the first heater 31 and the second heater 32.

30 10. The vaporizer as claimed in claim 6, the first heater 31 and the second heater 32 are unified to form a heater block 57 mounted on the lower end of the heater block 57.

11. The vaporizer as claimed in claim 2, wherein the liquid source supplying part 10 further includes a cooling device 18 in order to cool heat transferred from the vaporizing chamber 30.

5

12. The vaporizer as claimed in claim 5, the actuator 50 is any one selected from a manual actuator or a Piezo actuator.

10 13. The vaporizer as claimed in claim 2, wherein the gas transporting passage 37 is inclined to increase a thermal contact area in order for the transporting gas to absorb a heat from the vaporizing chamber 30 enough.

## Abstract

As described above, the present invention relates to a vaporizer integral with a diaphragm, the vaporizer comprising: a liquid source supplying part 10; a vaporizing part 30; a recess 16; a O-ring 17; said liquid source supplying part including a source intaking  
5 passage 11 for receiving a liquid source, an intaking tube 12 communicated with the source intaking passage 11 and having a fine hole 12a formed thereon, a stopper 13 formed on a place at which the source intaking passage 11 and the intaking tube 12 are joined together, an adjusting pin 14 for controlling supplying of the liquid source from the source intaking passage 11 to the intaking tube 12, and a diaphragm 15 integral with the adjusting pin 14;  
10 said vaporizing part 30 including a first heater 31 attached to a body of the vaporizing part 30 to heat the vaporizing part, a vaporizing chamber 35 for vaporizing the liquid source, a gas transporting passage 37 for supplying a transporting gas, and a discharging port 38 for communicating with the vaporizing chamber 35 and for discharging the transporting gas and the vaporized liquid source to the outside of the vaporizing chamber 35, and said recess 16  
15 being formed on selected one of the liquid source supplying part 10 and the vaporizing part 30 to minimize a thermal contact area therebetween, and coupled with the O-ring 17.